

Claims

What is claimed is:

1. A method of uplink communication between a mobile station and a base station of a wireless communication system, the method comprising the step of:

transmitting at least one of an uplink access signal and an uplink timing synchronization signal from the mobile station to the base station in a particular one of a set of recurring intervals in which regular uplink data transmission from at least one additional mobile station to the base station is at least partially suspended.

2. The method of claim 1 wherein the wireless system comprises an orthogonal frequency division multiplexed (OFDM) system.

3. The method of claim 1 wherein the set of periodically recurring intervals comprise a set of time slots that are synchronized to a downlink established between the base station and the mobile station.

4. The method of claim 1 wherein the base station in response to a generic uplink access signal assigns an uplink channel to the mobile station and subsequently transmits power control and synchronization information to the mobile station, such that the mobile station initiates a call set-up process over the assigned uplink channel.

5. The method of claim 1 wherein uplink synchronization is conducted on a group-by-group basis in which each of a plurality of mobile stations is assigned to one of M groups, and in each of at least a subset of the intervals, each of the mobile stations in a particular one of the M groups of mobile stations transmits an uplink timing synchronization signal, while each of the mobile stations in the other $M - 1$ groups suspends uplink transmission, and wherein the uplink synchronization cycle repeats every M intervals.

6. The method of claim 1 wherein a least a subset of a plurality of mobile stations adjust their uplink transmission times such that they are received synchronized at the base station.

7. The method of claim 1 wherein downlink and uplink timing are synchronized at the base station, and the mobile station initially synchronizes to the base station downlink, such that the mobile station is initially synchronized with a timing error of at most one round-trip propagation delay.

8. The method of claim 7 wherein the mobile station obtains the initial synchronization prior to acquiring an uplink channel, and remains synchronized in this manner even when access is not immediately required.

9. The method of claim 1 wherein in order to gain access, the mobile station transmits, in a timing and access interval, one of a set of designated access signals which are common for and known to all mobile stations attempting access to the base station.

10. The method of claim 1 wherein in each of a plurality of timing and access intervals, the base station searches for the presence of a transmitted access signal to determine if a mobile station is attempting access, and after detecting an access, utilizes control logic to determine whether the access can be granted.

11. The method of claim 1 wherein in response to a successfully detected access signal, the base station is configured to broadcast an acknowledgment or a negative acknowledgment in a downlink channel known to each of a plurality of mobile stations, wherein the acknowledgment contains an uplink and/or downlink channel assignment for the mobile station to initiate a call set-up process.

12. The method of claim 1 wherein the base station is operative to estimate the received signal power and arrival time of an access signal of the mobile station, such that if the access is

granted, the base station can send initial power and timing correction information in the access acknowledgment.

13. The method of claim 1 wherein access can be denied if the access signal was not received with sufficient power to ensure that the timing estimation has a desired level of accuracy.

14. The method of claim 1 wherein the mobile station is operative to perform identification, authentication and call set-up process initiation operations on assigned uplink and downlink channels after power levels and timing have been corrected via interaction with the base station.

15. The method of claim 1 wherein the base station performs a collision detection operation in order to detect a situation in which more than one mobile station has transmitted the same access signal in the same timing and access interval, and further wherein if a collision is detected, the access can be denied, and the base station broadcasts a specific collision alert signal on a downlink channel known to a plurality of mobile stations.

16. The method of claim 1 wherein in response to a negative acknowledgment or the lack of an acknowledgment the mobile station is operative to retransmit an access signal in a later timing and access interval.

17. The method of claim 1 wherein in order to reduce the probability of repeated collisions, each of a plurality of mobile stations are operative to select subsequent access signals from an access signal set in a manner which is independent of previous access signals selected by a particular mobile station.

18. The method of claim 1 wherein a plurality of mobile stations are operative to utilize a random back-off procedure to determine the time between subsequent access attempts, and to transmit subsequent access signals at a higher power in the event of a failure of a previous access attempt.

1 19. The method of claim 15 wherein when collision detection is not performed, or when the
2 detection is not fully reliable, the base station is operative to perform a reliability test on data
3 associated with the assigned channels to determine if more than one mobile station has attempted
4 to use the channel.

1 20. The method of claim 1 wherein the mobile station is operative to send a unique
2 identification as part of a call set-up process, and the base station is operative to re-transmit the
3 unique identification back to the mobile station in a downlink so that the mobile station can confirm
4 that it is the intended user of the channel.

1 21. The method of claim 1 wherein in order to track drifts in timing and to improve initial
2 synchronization, the mobile station is operative to continually re-synchronize throughout a period
3 for which it is connected to the base station.

1 22. The method of claim 1 wherein the mobile station is operative to re-synchronize by
2 transmitting a pre-determined timing re-synchronization signal in a designated timing and access
3 interval, and further wherein the base station is operative to measure the arrival time of the signal,
4 and deliver an appropriate timing correction back to the mobile station in a downlink.

1 23. The method of claim 1 wherein in each of a plurality of timing and access intervals, only
2 a designated subset of a set of mobile stations connected to the base station transmit re-
3 synchronization signals, so as to permit the mobile stations to use wider band signals for re-
4 synchronization than would otherwise be possible, and to free up additional bandwidth for the
5 access signals.

1 24. The method of claim 1 wherein the mobile station is assigned a re-synchronization
2 schedule comprising a sequence of intervals and re-synchronization signals to use during a call set-
3 up process, and further wherein the re-synchronization schedule ensures that timing re-

4 synchronization is sufficiently frequent to cover a maximum clock drift and change in round-trip
5 propagation delay between successive re-synchronizations.

1 25. The method of claim 1 wherein the base station is operative to request an additional re-
2 synchronization for a particular mobile station if the base station determines that such a re-
3 synchronization is required.

1 ~~26. An apparatus for uplink communication between a mobile station and a base station of~~
2 ~~a wireless communication system, the apparatus comprising:~~
3 ~~means for transmitting at least one of an uplink access signal and an uplink timing~~
4 ~~synchronization signal from the mobile station to the base station in a particular one of a set of~~
5 ~~recurring intervals in which regular uplink data transmission from at least one additional mobile~~
6 ~~station to the base station is at least partially suspended.~~

1 ~~27. An apparatus for use in a wireless communication system, the apparatus comprising:~~
2 ~~a mobile station uplink access and synchronization system operative to transmit at~~
3 ~~least one of an uplink access signal and an uplink timing synchronization signal to a base station of~~
4 ~~the system in a particular one of a set of recurring intervals in which regular uplink data transmission~~
5 ~~from at least one additional mobile station to the base station is at least partially suspended.~~

1 ~~28. A method of uplink communication between a mobile station and a base station of a~~
2 ~~wireless communication system, the method comprising the step of:~~
3 ~~receiving in the base station at least one of an uplink access signal and an uplink~~
4 ~~timing synchronization signal transmitted from the mobile station in a particular one of a set of~~
5 ~~recurring intervals in which regular uplink data transmission from at least one additional mobile~~
6 ~~station to the base station is at least partially suspended.~~

1 ~~29. An apparatus for uplink communication between a mobile station and a base station of~~
2 ~~a wireless communication system, the apparatus comprising:~~

means for receiving in the base station at least one of an uplink access signal and an uplink timing synchronization signal transmitted from the mobile station in a particular one of a set of recurring intervals in which regular uplink data transmission from at least one additional mobile station to the base station is at least partially suspended.

30. An apparatus for use in a wireless communication system, the apparatus comprising:
a base station uplink access and synchronization system operative to receive at least one of an uplink access signal and an uplink timing synchronization signal transmitted from a mobile station of the system in a particular one of a set of recurring intervals in which regular uplink data transmission from at least one additional mobile station to the base station is at least partially suspended.

31. A method of uplink communication between a mobile station and a base station of a wireless communication system, the method comprising the step of:
transmitting an uplink access signal from the mobile station to the base station in a particular one of a set of recurring intervals in which regular uplink data transmission from at least one additional mobile station to the base station is at least partially suspended.

32. A method of uplink communication between a mobile station and a base station of a wireless communication system, the method comprising the step of:
transmitting an uplink timing synchronization signal from the mobile station to the base station in a particular one of a set of recurring intervals in which regular uplink data transmission from at least one additional mobile station to the base station is at least partially suspended.

33. A method of uplink communication between a mobile station and a base station of a wireless communication system, the method comprising the step of:

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~~34.~~

[illegible]